Ap. Note – X-320
Environmental Sensor Compatibility

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Summary

The sensors listed in this document have been evaluated for compatibility with the X-320 inputs. The qualification level of the sensors is assigned one of the following ranks.

P = Preliminary – Review of publicly available data indicates compatibility. Data may not include slope and detailed electrical interface specifications.

D = Data sheet evaluation – Detailed review of electrical interface parameters. Slope and offset parameters are given if indicated in data sheet information.

B = Bench tested – Evaluation units have been electrically connected to the X-320 and operated. Full slope, offset, and any special electrical connections are given in the table or are available from Xytronix.

F = Field tested – Sensor has been connected to the X-320 and has been operated for an extended period of time in a field environment.

Desired sensors may use the same output mode, such as 0-5 V analog output. Users are responsible for selecting the appropriate sensors for their application and ensuring that the appropriate numbers of inputs or outputs are available. The X-320 has four analog inputs, 2 counter inputs, and one frequency input.

Some environmental sensors combine multiple functions such as wind speed and wind direction. These sensors typically have separate outputs for each function. Consequently, they are listed in multiple tables for each function such as Wind Speed and Anemometer sections.

Wind Speed (Anemometer)

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Davis	6410	Reed switch	n/a	Vertical panel	$121.00	F	2.250 (mph)	0	Digital In (Set to pull-up) Gnd	3-Cup anemometer combined with vane.
Met One	010C	11 Vpp Frequency	11-14 VDC (10 mA @ 12 VDC)	3/4” or 1” pipe See note.		P			Feq. Input Gnd	Requires PN 191 for mounting, includes fittings for both pipe sizes.
Met One	014Mini	Reed switch (10mAmax)	n/a	1/2” mast		D	0.79984 m/s	0.45	Digital In Gnd	3-Cup Anemometer.
Met One	014A	Reed switch (10 mAmax)	n/a	3/4” or 1” pipe See note.		P			Digital In Gnd	3-Cup Anemometer. Requires PN 191 for mounting, includes fittings for both pipe sizes.
Met One	034B	Reed switch (10 mAmax)	n/a	1” pipe	$495	B	.799 (m/s) 1.7873 (mph)	0.28 0.63	Digital In Gnd	3-Cup anemometer combined with vane.
NRG Systems	#40C	Frequency (0-125 Hz)	n/a	1/2” pole	$290	D			Freq. Input Gnd	
Young	12102	0-2.4 V @ 28.6 m/s	n/a	3/4” threaded pipe	$572	P			Analog Gnd	Gill 3-Cup Anemometer
Young	85000	0-5 V	9-16 VDC, 30 mA	1” pipe	$1,554	P			Analog In Gnd	Ultrasonic Anemometer combined with wind direction.
Young	81000	0-5 V	12-24 VDC, 110 mA	1” pipe	$2,590	P			4x Analog In Gnd	Ultrasonic Anemometer combined with wind direction.
Young	5103V	0-5 V	8-24 VDC (5 mA @ 12 VDC)	1” pipe	$1,184	P		0	Analog In Gnd	Combined speed and direction. Threshold of 1.0 m/s (2.2 mph) gives 20 Hz, 400 mVpp. At 0.5 mph the output is 2.3 Hz, 90 mVpp.
Young	5103	Frequency	n/a	1” pipe	$918	B	0.2192 (mph) 0.0980 (m/s) 0.3528 (km/s)	0	Freq. Input Gnd	Combined speed and direction. Threshold of 1.0 m/s (2.2 mph) gives 20 Hz, 400 mVpp. At 0.5 mph the output is 2.3 Hz, 90 mVpp.

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Wind Direction

Make	Model	Output	Power	Mount	Approx Cost	Qual	Slope	Offset	Connections	Notes
Davis	6410		n/a	Vertical Panel	$121.00	F	72	0	Analog In +5 Vref Gnd	
Met One	024Mini	0-10 kohm	5 mA	1/2” pipe		P				
Met One	024A	0-10 kohm	5 mA	3/4” or 1” pipe See note.		P				Requires PN 191 for mounting, includes fittings for both pipe sizes.
Met One	034B	0-10 kohm	5 mA	1” pipe	$495	B	72	0	Analog In +5 Vref Gnd	3-Cup anemometer combined with vane. **Add a 1 kohm resistor in series with 5 Vref to limit current to 5 mA.
Young	85000	0-5 V	9-16 VDC, 30 mA	1” pipe	$1,554	P			Analog In Gnd	Ultrasonic wind sensor.
Young	81000	0-5 V	12-24 VDC, 110 mA	1” pipe	$2,590	P			4x Analog In Gnd	Ultrasonic Anemometer combined with wind direction.
Young	5103	0-10 kohm pot.	0.5 mA	1” Pipe	$918	B	72	0	Analog In +5 Vref AGnd	Mechanical Wind Sensor, Combined with wind speed. A 1 Mohm pull down resistor is used inside of the instrument.

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Temperature

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Young	41382VC	0-1 VDC	10-28 VDC	Rad shield	$788	B	C: 20	C: -50	5Vref Agnd Ain	Rel. Hum./Temp Probe (C) 41003P or 43502 radiation shield required.
Young	41382VF	0-1 VDC	10-28 VDC	Rad shield	$788	B	F: 40	F: -50	5Vref Agnd Ain	Rel. Hum./Temp Probe (F) 41003P or 43502 radiation shield required.

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Young	41342VC	0-1 VDC	10-28 VDC	Rad shield	$438	D	C: 20	C: -50	5Vref Agnd Ain	Temp. Probe (C) 41003P or 43502 radiation shield required.
Young	41342VF	0-1 VDC	10-28 VDC	Rad shield	$438	D	F: 40	F: -50	5Vref Agnd Ain	Temp. Probe (F) 41003P or 43502 radiation shield required.
Young	41003	n/a	n/a	Pole	$146	B	n/a	n/a	n/a	Passive radiation shield.
Young	43502	n/a	12-14 VDC (500 mA)	Pole	$434	P	n/a	n/a	n/a	Active (fan aspirated) radiation shield.
Xytronix	X-DTS-U X-DTS-WM X-DTHS-WM X-DTS-S12	1-Wire			$9.99 $22.95 $93.60 $46.18	F	F: 1.0 C: 0.5555	F: 0 C: -17.778	5 Vout Gnd Data	

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Humidity

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Young	41382VC	0-1 VDC	10-28 VDC	Rad shield	$788	B	%RH: 20	0	5Vref Agnd Ain	Rel. Hum./Temp Probe (C) 41003P or 43502 radiation shield required.
Young	41382VF	0-1 VDC	10-28 VDC	Rad shield	$788	B	%RH: 20	0	5Vref Agnd Ain	Rel. Hum./Temp Probe (F) 41003P or 43502 radiation shield required.
Met One	083E	0-5 VDC (option)	10-14 VDC (4 mA @ 12 VDC)			P				Available with optional temperature.

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Lightning Detection

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
WXLine	StrikeGuard	N.O. Switch	120 VAC	Platform		D	n/a	n/a	Digital In (Set to pull up) Gnd	StrikeGuard is composed of a sensor module that is mounted outside and connected to a Data Receiver. The connection to the ControlByWeb module is on the receiver.

Precipitation

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Davis	7852	N.O. Switch	n/a	Platform	$71	F	0.01 (in) .254 (mm)		Digital In (Set to pull up) Gnd	Tipping Bucket Rain Gauge. Kit available to convert to 0.02mm bucket measurement.
Young	50202	0-5 VDC	8-30 VDC	U-bolts on 1-2” pipe	$1,220	D				Precipitation Gauge, Capacitive
Young	52202	N.O. Switch	18 W, Heater only	1” pipe	$604	B			Digital In (Set to pull up) Gnd	Tipping Bucket Rain Gauge, Heated
Young	52203	N.O. Switch	n/a	1” pipe	$466	B	0.00393 (in)	0	Digital In w/ pull up Gnd	Tipping Bucket Rain Gauge, Unheated
WaterLog	H-340	N.O. Reed Switch					in: 0.01 mm: .254			
Met One	360	N.O. Reed Switch					in: 0.01 mm: 0.254		Digital Input Gnd	Model 365 is the heated version.
Met One	364	N.O. Reed Switch					in: 0.00394 mm: 0.1		Digital Input Gnd	Model 369 is the heated version.

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Solar Radiation

Solar radiation configuration can be validated at clearskycalculator.com. The calculations assume a clear sky and should be within about 3% within one hour of solar noon.

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Apogee Instruments	SP-215	0-5 VDC	5 VDC, 285 uA	Apogee Shelf	$219	F	250 (W/m^2)	0	Analog Input 5 Vref AGnd	Use with Apogee leveling plate.
Davis Instruments	6450	0-2.5 VDC	3 V, 1 mA	Davis Shelf	$160	F	598.88 (W/m^2)	0	Analog Input 5 Vref (See note.) AGnd	A voltage divider between +5Vref and Agnd was used for testing. A series network with a 220 Ohm and a 330 Ohm resistor between +5Vref and AGnd was tested.
Met One	096			Plate or Pole		D			Analog Input 5 Vref AGnd	

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Soil Moisture

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Irrometer	200SS-V	0-2.8 VDC	3.2-30 VDC (1.5 mA)	n/a	$88.00	D	85.36	0	Analog Input +5 Vref GND	2.9 V output = Fault code 3.0 V output = Open circuit fault code

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Barometric Pressure

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Apogee Instruments	SB-110	0-5 VDC	5 VDC	None	$45	F	218 (hPa) 6.437 (mmhg)	114-122.78 3.637	Analog Input +5Vref AGnd	Not temperature compensated.
Comet	2114	4-20 mA		Panel	$385	D				Quantity discounts for 2 units, $345. 100 units is $270 each. Version without display is approximately $15 cheaper.
Met One	92	0-5 VDC	6-16 VDC (10 mA @ 12 VDC)	See note.	$550	P				Mounting plate may be screwed to wall/panel or U-bolts to pole.
Novalynx	110-WS-16BP	0-5 VDC	10-18 VDC	Panel	$200	D			Analog Input +5Vref Agnd	Hardware altitude offset max of 10,000 ft. Not temperature compensated.
NRG Systems	NRG #BP20	0-5 VDC	7-35 VDC (15 mA)		$330	D	217.8 (hPA)	105.5		
Setra	278 (2781-600M-A-1B-2B-T1)	0-5 VDC	9.5 to 28 VDC	Panel	$625	D			Analog Input +5Vref AGnd	Campbell Scientific CS100
Vaisala	SPH10	n/a	n/a	Bracket	$270	D			n/a	For use with PTB210.
Vaisala	PTB210C3C1M		8-18 VDC (8 mA)	Bracket	$1,020	D			Analog Input +5Vref AGnd	Mounting bracket included with sensor. Use with SPH10
Vaisala	PTB1101A1AB	0-5 VDC	10-30 VDC (4 mA)	DIN rail	$960	D			Analog Input +5Vref AGnd	Use with pressure head and tube, such as the RM Young 61002.
Young	61002	n/a	n/a	1-2” Pipe	$142	D			n/a	Use with Young 61302, Vaisala PTB110, or Vaisala 210.
Young	61302V	0-5 VDC	7-30 VDC, 2.8 mA	Enclosure	$622	D				May be used with 61002 pressure port.

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Water Level and Pressure

Make	Model	Output	Power	Mount	Approx Price	Qual	Slope	Offset	Connections	Notes
Setra	528	0-5 VDC	6.5-35 VDC (6 mA)	Submersible					Analog Input +5 Vref Agnd	
Stevens	93720	4-20 mA	14-35 VDC	Submersible	$295.00	D				Submersible Water Pressure sensor Shunt resistor required.

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Station Configuration

Option 1 – Low Cost Weather Stations

Functions	Manufacturer	Model	Price	X-320 Connection	Slope	Offset	Notes
Temp, Hum, Wind, Rain	Davis	6322C	$257.00	2x Digital Input, 1x Analog Input, +5 Vref, Agnd, Gnd	Wind Speed: 2.25 (mph) Wind Direction: -72	0 360	Optional: Fan Kit (7747), Solar Radiation (6450), and Shelf (6673) as necessary. **Use Xytronix Adapter Board
Temp, Hum, Wind, Rain, UV Sensor, Solar Radiation Sensor	Davis	6327C	$675.00	1-Wire Bus, 1x Digital Input, 2x Analog Input, +5 Vref, Agnd, Gnd	Wind Speed: 2.25 (mph) Wind Direction: 72 Solar Radiation: 598.80 (W/m^2)	0 0 0	Add fan kit (7747) as necessary. **Use Xytronix Adapter Board
Temperature	Xytronix	X-DTS-U	$9.99	1-Wire Bus, +5 V, GND	n/a	0	Optional, up to 6 including
Temperature and Humidity	Xytronix	X-DTHS-WM	$93.60	1-Wire Bus, +5 V, GND	n/a	0	Optional multiple sensors
Radiation Shield, Active	Davis	7747	$135.00	n/a	n/a		Solar powered fan kit addition to 6322C or 6327C.
Solar Radiation	Davis	6450	$160.00	1x Analog Input, +5 Vref, GND	Solar Radiation: 598.80	0	
Soil Moisture	Irrometer	Watermark 200SS-V	$55.00	1x Analog Input, +5 Vref, GND			
Shelf, Sensor Mounting	Davis	6673	$30.00	n/a	n/a	n/a	Used for mounting Solar Radiation sensor to rain bucket, 7852
Barometric Pressure	Apogee Instruments	SB-110	$45.00	1x Analog Input, +5 Vref, GND	6.437 mmHg	3.64	
Xytronix Adapter Board, Davis ISS	Xytronix	X-MDA-1	$79.95	n/a	n/a	n/a	

Option 2 – Commercial/Research Weather Station

Function	Manufacturer	Model	Price	X-320 Connection	Slope	Offset	Notes
Radiation Shield, Davis	Davis	7714	$75.00	n/a	n/a	n/a	Use with Xytronix sensors.
Wind Sensor	Young	5103	$918.00	Freq. Input, Gnd	0.2192 (mph) 0.0980 (m/s) 0.3528 (km/s)	0 0 0	
Precipitation	Young	52203	$466.00	Digital In, Gnd	0.00393 (in)	0	
Solar Radiation	Apogee Inst.	SP-215	$219.00	Analog Input, +5 Vref, AGnd	250 (W/m^2)	0	Requires mounting bracket and leveling plate.
Apogee Mounting Bracket	Apogee Inst.	AM-110	$35.00	n/a	n/a	n/a	
Apogee Leveling Plate	Apogee Instruments	AL-100	$29.00	n/a	n/a	n/a	
Temperature/Humidity	Young	41382VC	$788.00	2x Analog In, +5 Vref, AGnd	Temp: 0.555 (C) Hum: 20	-17.77 0	41003 or 43502 radiation shield required.
Radiation Shield, Passive	Young	41003	$146	n/a	n/a	n/a	
Radiation Shield, Active	Young	43502	$434	n/a	n/a	n/a	Requires external power
Barometric Pressure	Setra	278	$625.00	Analog In, +5 Vref, AGnd			Campbell Scientific CS100
Soil Moisture	Irrometer	Watermark 200SS-V	$55.00	Analog Input 3, +5 Vref, GND	85.36	0	2.9 V output = Frozen Sensor Fault code 3.0 V output = Open Circuit Fault Code

Revision History

Rev	Description	Author	Approval Date	Approved By
A	Initial Release	E. Bodrero	13. Apr. 2011	D. Witbeck
B	Update Field Tested Sensors	E. Sargent	8. Feb. 2012	D. Witbeck